


PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference PFC 1670 PCT		FOR FURTHER ACTION		See Form PCT/IPEA/416
International application No. PCT/GB2005/000077		International filing date (day/month/year) 12.01.2005		Priority date (day/month/year) 13.01.2004
International Patent Classification (IPC) or national classification and IPC C08G75/00, C08G75/23, C08G73/10, H01M8/00, H01M8/02, H01M8/10				
Applicant JOHNSON MATTHEY PUBLIC LIMITED COMPANY et al.				
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 8 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau) a total of 2 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>				
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input checked="" type="checkbox"/> Box No. II Priority</p> <p><input checked="" type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input checked="" type="checkbox"/> Box No. VI Certain documents cited</p> <p><input checked="" type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input checked="" type="checkbox"/> Box No. VIII Certain observations on the international application</p>				
Date of submission of the demand 28.10.2005		Date of completion of this report 29.11.2005		
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized Officer Glomm, B Telephone No. +49 89 2399-7158		



**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/GB2005/000077

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

Description, Pages

1-28 as originally filed

Claims, Numbers

1-16 received on 28.10.2005 with letter of 25.10.2005

Drawings, Sheets

1/6-6/6 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/GB2005/000077

Box No. II Priority

1. ☐ This report has been established as if no priority had been claimed due to the failure to furnish within the prescribed time limit the requested:
 - ☐ copy of the earlier application whose priority has been claimed (Rule 66.7(a)).
 - ☐ translation of the earlier application whose priority has been claimed (Rule 66.7(b)).
2. ☐ This report has been established as if no priority had been claimed due to the fact that the priority claim has been found invalid (Rule 64.1). Thus for the purposes of this report, the international filing date indicated above is considered to be the relevant date.
3. Additional observations, if necessary:
see separate sheet

Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:
 - ☐ the entire international application,
 - ☐ claims Nos.
because:
 - ☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (specify):
 - ☐ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. are so unclear that no meaningful opinion could be formed (*specify*):
 - ☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.
 - ☐ no international search report has been established for the said claims Nos.
 - ☐ the nucleotide and/or amino acid sequence listing does not comply with the standard provided for in Annex C of the Administrative Instructions in that:
 - the written form ☐ has not been furnished
 - ☐ does not comply with the standard
 - the computer readable form ☐ has not been furnished
 - ☐ does not comply with the standard
 - ☐ the tables related to the nucleotide and/or amino acid sequence listing, if in computer readable form only, do not comply with the technical requirements provided for in Annex C-*bis* of the Administrative Instructions.
- ☒ See separate sheet for further details

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/GB2005/000077

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	
	No: Claims	1-16
Inventive step (IS)	Yes: Claims	
	No: Claims	1-16
Industrial applicability (IA)	Yes: Claims	1-16
	No: Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Box No. VI Certain documents cited

1. Certain published documents (Rule 70.10)

and / or

2. Non-written disclosures (Rule 70.9)

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Cited documents:

- D1: EP-A-1 238 998 (SUMITOMO CHEMICAL COMPANY, LIMITED) 11 September 2002 (2002-09-11)
- D2: EP-A-1 354 907 (TOYO BOSEKI KABUSHIKI KAISHA) 22 October 2003 (2003-10-22)
- D3: US 2002/164513 A1 (ASANO YOICHI ET AL) 7 November 2002 (2002-11-07)
- D4: WO 02/25764 A (VIRGINIA TECH INTELLECTUAL PROPERTIES, INC) 28 March 2002 (2002-03-28)
- D5: US 2003/032739 A1 (KERRES JOCHEN ET AL) 13 February 2003 (2003-02-13)
- D6: WO 01/25312 A (COMMISSARIAT A L'ENERGIE ATOMIQUE; CENTRE NATIONAL DE LA RECHERCHE SCI) 12 April 2001 (2001-04-12)
- D7: WO 00/24796 A (FOSTER-MILLER, INC; FORMATO, RICHARD, M; OSEAR, PAUL; KOVAR, ROBERT,) 4 May 2000 (2000-05-04)
- D8: WO 00/09610 A (THE RESEARCH FOUNDATION OF STATE UNIVERSITY OF NEW YORK) 24 February 2000 (2000-02-24)
- D9: US-B1-6 620 546 (MICHOT CHRISTOPHE ET AL) 16 September 2003 (2003-09-16)
- D10: US-A-5 679 482 (EHRENBERG ET AL) 21 October 1997 (1997-10-21)
- D11: US-A-5 693 740 (COLQUHOUN ET AL) 2 December 1997 (1997-12-02)
- D12: WO 2004/088778 A (VICTREX MANUFACTURING LIMITED; CHARNOCK, PETER; DEVINE, JOHN, NEIL; WI) 14 October 2004 (2004-10-14)
- D13: WO 2004/090015 A (MITSUI CHEMICALS, INC; FUJIYAMA, SATOKO; OMI, TAKEHIKO; ISHIKAWA, JUNI) 21 October 2004 (2004-10-21)

1. Novelty (Art. 33 (2) PCT)

Each of cited documents D1 to D11 discloses polymers as specified in detail in present independent main claim 1 (for relevant passages, see the corresponding

International Search Report).

The attention of the applicant is drawn especially to the fact, that the terms as specified in present independent main claim 1 in lines 2/3 of the feature (a) (" ... wherein at least ... "), on the one hand, and in lines 2/3 in feature (b) (" ... wherein no ion-conducting ... "), on the other hand, respectively, appear to be implicitly disclosed by each of said documents D1 to D11 in view of the principles of the established official rules of practice.

The same considerations also relate to the additional feature as specified in the last two lines of the new amended independent main claim 1 (" ... such that at least 80 % of the polymer ..."). Implicit (or inherent) disclosure corresponds to the fact, that the claimed product is regarded as being anticipated actually by said prior art documents, even if the claimed parameters or terms as specified in the said lines of present main claim 1 are not expressly mentioned therein, i.e., the parameters or terms are regarded as being actually present in the prior art embodiments, but simply not determined and/or mentioned expressly therein.

Consequently, each of said documents D1 to D11 anticipates the subject matter of present claim 1.

The same considerations also relate to the additional features of the following claims 2 to 16 when taking into account the full disclosure of each of said documents D1 to D11.

Therefore the subject matter of present application is not new in view of the disclosure of each of said documents D1 to D11.

2. Inventive Step (Art. 33 (3) PCT)

Providing an amended main claim which meets the requirements of Art. 33 (2) PCT, the applicant should relate the distinguishing feature to a surprising (unexpected) technical effect or make credible or plausible that the distinguishing feature is not derivable from the prior art teaching (Art. 33 (3) PCT).

3. Miscellaneous

The terms as specified in present independent main claim 1 in lines 2/3 of the feature (a) (" ... wherein at least ... "), on the one hand, and in lines 2/3 in feature (b) (" ... wherein no ion-conducting ... "), on the other hand, respectively, appear to attempt a definition of the subject matter to be protected by means of the corresponding results to be achieved, rather than by means of clear and unambiguous technical features, such violating the Art. 6 PCT. Furthermore, the said terms do not represent clear and unambiguous technical features, but relative terms having no clear and unambiguous meaning among the average persons skilled in the art.

The same considerations also relate to the additional feature as specified in the last two lines of the new amended independent main claim 1 (" ... such that at least 80 % of the polymer ..."). The applicant therefore is invited in the subsequent European regional phase, if any, to replace said objected terms by clear and unambiguous technical features based on suitable subclaims or relevant passages taken from the present description.

The attention of the applicant is drawn to the fact, that each of documents D12

**INTERNATIONAL PRELIMINARY
REPORT ON PATENTABILITY
(SEPARATE SHEET)**

International application No.

PCT/GB2005/000077

and D13 will be relevant for the assessment of novelty under the Arts. 54 (3, 4) EPC in the subsequent European regional stage, if any.

In order to improve the understanding and legibility of the application, in the European regional phase, if any, the applicant is invited to identify the documents D1 to D10 in the description additionally and briefly discuss the relevant background art disclosed therein.

When filing amendments, any undue extension of the scope of the application should be avoided.

CLAIMS

1. A polymer wherein at least 80% of the repeat units comprise
 - a) an ion-conducting region having an aromatic backbone of one or more aromatic groups, wherein at least one ion-conducting functional group is attached to each aromatic group; and
 - b) a spacer region having an aromatic backbone of at least four aromatic groups, wherein no ion-conducting functional groups are attached to the aromatic backbone,such that at least 80% of the polymer chain contains alternate ion-conducting and spacer regions along the length of the chain.
2. A polymer according to claim 1, wherein at least 95% of the repeat units comprise the ion-conducting region and the spacer region.
3. A polymer according to claim 1 or claim 2, wherein the one or more aromatic groups in the ion-conducting region are phenylene, naphthylene or anthracenylene groups.
4. A polymer according to any preceding claim, wherein each aromatic group in the aromatic backbone of the ion-conducting region is adjacent to an electron-donating group.
5. A polymer according to claim 4, wherein the electron-donating group is an ether group.
6. A polymer according to any preceding claim, wherein the at least one ion-conducting functional group is a sulphonic acid group.
7. A polymer according to any preceding claim, wherein the ratio of the number of aromatic groups in the spacer region to the number of aromatic groups in the ion-conducting region is at least 2:1.
8. A polymer according to any preceding claim, wherein the at least four aromatic groups in the spacer region are phenylene, naphthylene or anthracenylene groups.
9. A polymer according to any preceding claim, wherein the at least four aromatic groups in the spacer region are connected by electron-withdrawing groups.

10. A polymer according to claim 9, wherein the electron-withdrawing groups are sulphone or ketone groups.
11. A polymer according to any preceding claim, which has an equivalent weight of less than 800g mol^{-1} .
12. A polymer according to any preceding claim, which has an inherent viscosity of greater than 1.0dl/g .
13. A polymer solution comprising a polymer according to any one of claims 1 to 12.
14. A polymer electrolyte membrane comprising a polymer according to any one of claims 1 to 12.
15. An electrocatalyst layer on a substrate wherein the electrocatalyst layer comprises a polymer according to any one of claims 1 to 12.
16. A membrane electrode assembly comprising a polymer electrolyte membrane according to claim 14 and/or an electrocatalyst layer according to claim 15.